ENGINEERING NEWS.

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GEO. H. FROST.....PROPRIETOR.
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THE regular edition of *St. Nicholas* in England is now eight thousand copies. Ten thousand copies of the Christmas number are being sold there.

THE attention of contractors is called to the large contract on the Boston Improved Sewerage—advertised elsewhere in this journal this week—to be let on the 24th inst.

THE new international railroad line, which is to give more direct communication between France and Spain, will necessitate another large tunnel. The Pyrenees will be cut, much to the disgust of some of the military folk of both countries. The expense of the tunnel will be paid by the Spanish and French governments. It will be six thousand, six hundred meters in length.

A QUESTION FOR RAILROAD EXPERTS: WHAT IS "GRADING?"—A case of some importance in a neighboring State will be brought before the courts on a question as to what constitutes the "grading" of a railroad; one side claiming that it embraces, in addition to cuts and fills, the construction of bridges and culverts, or in other words the preparation of the entire road-bed ready for the cross-ties; the other claiming that the grading includes only the cuts and fills.

As there is something to be said on both sides of this question, we should be pleased to furnish space for such as may be disposed to state their views or discuss the question, pro and con.

AT a meeting of the Civil Engineers' Club of Cleveland, held on the evening of Dec. 13, an interesting paper on the "Crystallization of Iron' was read by Mr. N. P. Bowler. It called forth quite an animated discussion, and a relation of the experience of members of the club on the subject. It is on the programme for the next meeting, when more will be said on the question, "What Causes Crystallization." The proceedings of this organization are published monthly in a very neat pamphlet, in connection with those of the clubs of Boston, Chicago and St. Louis.

G. B., of Lowell, Mass., writes us as follows:

"Will you club ENGINEERING NEWS with other papers this year the same as last? If so, let me know what the price of ENGINEERING NEWS and the *Century Magazine* will be. I see that club agents offer them at quite a reduction."

In answer thereto we repeat what we have heretofore published, that we will club with any newspaper, magazine or periodical in the country, and will allow *all the commission that we receive*, less five cents for transacting the business. The Harper's and the Century magazines are $4.00. We will send them to *any address*, and in any number sent us *by subscribers* to our journal at $3.25; if any news agent can do better, he has the "inside track," and we yield it to him. Our subscribers can always rely on getting more for their money by dealing *direct* with us than through any news agent; these gentlemen are useful in their way, but their labor in the field of class-journal circulation is so small as to be hardly appreciable.

THE January *Century*, a large edition of which is on the press, will be delayed this month until the 23d. One of its novel features is to be a frontispiece printed in tint—a portrait of ex-President Thiers, accompanying an article by the Hon. Elihu B. Washburne, our former Minister to France. A full-page portrait of Queen Margaret of Italy is given in connection with an article on the making of Burano lace, for which the Princess Louise of England has made a sketch. The number also has another portrait of President Garfield (from an artotype by Edward Bierstadt, N. Y.), which will accompany an anecdotal paper by Colonel A. F. Rockwell, entitled "From Mentor to Elberon." The immediate friends of the late President regard this portrait as giving a somewhat different phase of the late President's character from that presented by the engraving by Cole in the December *Century*, and as revealing his affectionate qualities, while the latter was especially strong on the intellectual side of his nature. The artotype is also interesting as being the portrait Mrs. Garfield selected to send to Queen Victoria. The sale of the November and December *Century* still continues. A new edition of nine thousand of the latter number has just been issued.

THE giant forces which scientific discovery is putting in the hands of engineering bid fair to develop a particular form of the profession. Works, the very immensity of which prevented the thought of their being entertained in former times, are now, as it were, the very objects which speculative syndicates and courageous companies are looking after. Oceans are joined together, mountains leveled and the face of nature considerably "transmogrified." A special class of engineers are being educated for these works, but although some of the world-famous projects are nearly finished, others are cropping up at such a rate that there is no likelihood of an immediate dearth of employment.

The Isthmus of Corinth is now to be cut, for a company has just been definitively constituted, and the report by General Turr has been drawn up. The territory of the isthmus is comprised between the Geranian mountains, which vary in height from 1,800 to 3,000 feet. M. Gerster, who had been already engaged in the Darien survey for the interoceanic canal, was sent with a number of engineers to make the necessary surveys. Three lines have been surveyed and leveled. The first coincides with the line laid out by the engineers employed by the Emperor Nero in the second half of the first century of our era. It is 6,342 meters in length, and is 78 meters above the sea level. There are two variations of this line, one of which starts from Kechrioes on the Ægean Gulf and follows the valley of the river Levka, falling into the Southern Sea near the modern city of Corinth. This line is eleven kilometers.

The surveys show that the line of the ancients gave 9,430,000 cubic meters, while the latter gives 12,424,000 cubic meters. The line adopted by Nero is straight, while the others have numerous curves of a minimum radius of 2,000 meters. In addition to this advantage possessed by the former line, there are some others. Soft sandstone and calcareous gravel form the principal elements of the soil, and the slopes are so that the canal would be protected from the drainage of the valley waters, etc. The advantages of having a straight line for navigation are simply of an imperative order.

The depth of water and width at top would be the same as for the Suez Canal—eight meters and twenty-two meters respectively.

The distance gained by the canal would be one hundred and eighty-five miles from the Adriatic to the Piraeus, and ninety-five miles for vessels from the Mediterranean. Even in Periander's time, 625 B. C., there was "some talk" of cutting the isthmus. There is nothing "new under the sun" it would almost appear after all.

SEWERAGE OF AMERICAN CITIES AND TOWNS.

In the *Journal d'Hygiène* for November we find a report in brief of the system of sewering pursued in the city of Memphis, Tenn., by George E. Waring, Jr., with an engraved plan of the city, showing the lines of main and branch sewers, as also plans of the accessories in use there, and we are led to notice this paper in connection with reviews of the sewerage works of American cities, as the claims made in support of the introduction of the system in Paris, rest mainly upon its successful working in Memphis.

After explaining the principle of this working, which consists in confining the sewers proper of a city to the discharge solely of the house waste (for which a pipe of very small diameter will suffice), he endeavors to show that instead of increasing the water supply, or increasing the volume of water in the mains, by introducing the rain water from roofs, yards and streets, with a view to the better sweeping of the fecal and other house wastes to the outlet, it is better, in a sanitary point of view, to so concentrate the discharge from the houses as to insure the regular periodical flushing of the contents of the small sewer by means of the ordinary water supply husbanded by means of flushing tanks located at the head of the branch sewers, and declares that the system is as applicable to the City of Paris of over two millions of people, as to the City of Memphis of less than forty thousand, and we cannot deny that there is much of plausibility in the arguments brought forward in support of this view. There is no novelty in them, however, and in the proper place we would be ready to accord them their full weight, but not to the extent perhaps of admitting that, "if Paris were in possession of a net work of sewers, constructed on the model of that of Memphis, all its filth could be carried away through the application of the Fields flushing tank, with a volume of water ten times less than what they consider to-day is indispensable." It is at once evident that unless the sewage can be deodorized, the Seine, the natural outlet for all this sewage, would become little better than an elongated cesspool, and would call for extra works of some sort for its purification or removal. And it is precisely here that our objection to the system proposed by Mr. Waring comes in. He admits the necessity, in the case of Paris, for treating this sewage, so far as to render it innocuous primarily, and of value to the agriculturist secondarily, as is done now at Gennevilliers. To utilize or to render innocuous the sewage of a couple of millions of inhabitants, which it is admitted, under this system, will become necessary, will be found to be a problem of great intricacy, if, indeed, its successful solution be possible. At all events, in this country of wide areas, there can be no market for the manufacture of feeble manure from sewage, in competition with the rich phosphates and guano, the supply of which equals all the wants of the agriculturist.

In the older countries of Europe, where such a thing as virgin soil cannot be found within any reasonable distance from the large cities, and where the system of police is, in most cases, as perfect as can be desired, or at all events, where the action of the executive in state or municipal affairs is not hampered by the sentiments of the superior claims of the individual voter to consideration, it would be possible to carry out this system as proposed for Paris, to a degree of success entirely beyond anything we could hope for in this country, and we are entirely willing that the city of Paris should lead the way and show how far it is possible to realize such an image as the "beautiful Seine cleansed of its daily pollution and emerging

from Paris with the natural limpidity restored, which it possessed before entering it."

The proposed system, if applied in Paris, will only effect by water carriage what is now effected by mechanical means.

The authorities have long resisted the introduction of the English system of water carriage, and but small advance has been made in that direction. The water-closets discharge into cess-pools within the premises, emptied at intervals, greater or less, by machinery and carried out of the city in *tonneaux*. All surface or other water is discharged into the main sewers; there are no pipe sewers in Paris. The contents of these cess-pools must, therefore, be richer in manurial ingredients than if the water supply were increased to the extent of sweeping the house sewage to the outlet, as at Memphis. Then we might reasonably expect that the value of the present sewage would be greater than by the proposed improvement.

In Paris the business of removal and preparation of the manure is let to a contractor, and he would appear to make a gain out of the transaction; that is, the public funds are benefited by it; but not so the tax-payers. They pay a considerable sum for the emptying of their cess-pools, 8 francs a cubic meter, 15 francs for a *fosse mobile*, and Mr. Krep calculated that the resulting *poudrette* sells for 47½ francs, which costs the city 146 francs!

EAST RIVER BRIDGE.

Ex-Controller Steinmetz lectured on Sunday, 11th inst., before the "Spread the Light Club," (whatever that may be), on municipal affairs, but, in reality, it would appear, that the occasion was merely made use of to attack the integrity of his former associates in the trusteeship of the important work of the East River bridge. He indulges in some plain speaking, such as "perhaps an explanation from Mr. Kingsley and his special associates in the board of trustees will be exacted by an outraged people ere the next legislature is permitted to vote away another million and a half of their money," and that, prior to obtaining any further aid, "the board of trustees should submit a complete and final plan, from which no changes are to be made, to a committee of *competent* engineers and contractors, and all disbursements hereafter to be made by the controllers of the two cities, upon approved vouchers of the commissioners of public works respectively," and speaks of "guesses," and "schemes hatched in secret conclaves," and "doctored contracts," and finally, after referring to the corrupt city government, and suggesting plans for the future, winds up with, "how long, oh, Lord! how long?"

As the adjourned meeting of the board of trustees was to take place on the 12th inst., and highly interesting proceedings were anticipated, the ex-controller and trustee perhaps thought that his thunder would produce some stir or sensation among the culprits—possibly be referred to a committee with power. But if he had any such hopes, the closing paragraph of the report of the proceedings of the club, of which, whether a member or not, he saw fit to make the vehicle of his lucubrations, would, or should, have shown him the futility of any such hopes. In the discussion which followed his lecture, it seems that the views of the association were to the effect "that all salaries of office-holders should be reduced; that all street railroads, ferries, gas companies and city property should be owned by the citizens at large, and that houses should be rented to the people directly by the municipality!"

The meeting of the trustees which took place on the 12th had been looked forward to with much interest by all interested in this most costly improvement, in hopes that the schism which has evidently existed for some time between the trustees of the respective cities would be healed.

It was known that the report of the committee of 1878, which has been referred to as giving authority for alterations in the plan, gave no such authority, and was made some twelve months before the contract with the Edgemoor Company was executed, and Mr. Roosevelt, in quoting from the Committee Report of 1878, says: "That the bridge is capable of supporting 1,100 tons of dead weight;" and, as he understood the term dead weight, "it meant the weight of the bridge itself," the term live load being applied to a rolling load, and adds: "Now, there has been added to the weight of the bridge itself, according to the Engineer's report, 1,200 tons more, and it would seem to the mind of one who is not an engineer that we had put on all that the bridge can bear, and there seems to be some reason to suppose that the whole thing may fall down."*

"The factor of safety, according to the committee's report, was to be six; according to the engineer's report it has been reduced to three. Now, who has made this change, and when was it made?" Mr. R. went on to say "that *somebody* had adapted the bridge to the use of palace cars without the authority of the board—without even the knowledge of the board;" and further, "the engineer implies that some one forced this change against the judgment and opinions and wishes of the chief engineer. Is this so or not? And if the steel is safer than the iron, as we are told, the increase of safety has been acquired against the engineer's judgment."

Certain of the trustees showed a commendable desire for information beyond the written record, and the public just now are very much exercised as to the truth or falsehood of various rumors as to the safety of the bridge, etc.; but nothing was done to relieve this anxiety or to come to any definite understanding. Of course, no notice whatever was taken of ex-controller and ex-trustee Steinmetz's complimentary lecture.

There was a warm discussion, and much was said which had better have been left unsaid. A vote of censure against some unknown individual or individuals was moved, having no reference to the ex-controller and was tabled, and a resolution was passed asking certain information of the engineer, and also a committee appointed to report upon the contract with the Edgemoor Iron Company, and whether the bridge trustees have grounds for an action for damages against the said company, after which the board adjourned to meet on the second Monday in January next, until which time the public must wait with what patience they may.

There is a circumstance which comes to light in these discussions of the board, which cannot but impress itself upon all who are interested in the subject matter, and that is, that in a work of such magnitude, and where, from its nature, there are so many points requiring technical explanation, there should not have been an accredited officer, a confidential assistant of the chief engineer, who, in the lengthened absence of the latter, should have been present with the Board at all times when any professional question was under discussion, not to give his advice, necessarily, but for purposes of explanation of technicalities. Had such measures been taken, the present misunderstanding, for it is nothing more, could not have arisen, and this unseemly squabble would have been prevented.

There is another point, which a careful study of the operations of this board of trustees reveals in our opinion, and we give it for the benefit of such timid souls as know nothing of the *modus operandi* of great achievements, yet are prone to the belief that what they cannot see is equally obscure to others, or if known, is concealed from unworthy motives. It is this: There is some one individual connected with this work, possibly a trustee himself, who, with a far sightedness which could not have been understood, had it been revealed, has persistently labored, from the inception of the work to the present moment, in the effort and in the determination, that this structure, instead of being a mere convenience between the two cities, should, by its capacity to meet all demands upon it, become a factor, and no mean one, in shaping the destiny of a section of country, which without it, had been little better than a barren waste. The cost to taxpayers was a secondary consideration with him, satisfied in his own mind that the hereafter would fully justify the outlay, and from present appearances there need be no fear of a failure of his scheme from any cause.

*To dissipate such fears as are referred to by the trustee, we would append the following, with the understanding that it claims no greater degree of accuracy than can be derived from a perusal of the printed reports of the Bridge Trustees which have appeared from time to time, and the legitimate deductions therefrom. The calculations refer exclusively to the river span, or the portion of the bridge between the towers.

	Tons.
Weight of river span	5,976
Of this there is supported by stays	1,439
Supported by cables	4,537
To this is added by late estimate of Chief Engineer	500
Making supported by cables	5,037
The load on one cable would be ¼, or	1,259

The strain on the cable by this weight will be the weight multiplied by co-efficient of tension = 1.64.

Then strain on one cable, by weight of bridge, $1.259 \times 1.64 = 2.064$ tons.

The maximum traffic of the bridge has been estimated as 1,311 tons on river span, ¼ = 328 tons.

The strain caused by this on a cable is $328 \times 1.64 = 538$ tons.

Then $538 + 2.064 = 2,602$ tons is the strain on a cable, caused by the weight of bridge, loaded with the maximum estimated traffic the *breaking* strain of a cable being estimated as 12,300 tons. This gives a factor of safety (so-called) of 4.7. But the method of comparison of strains with the breaking strain is very unsatisfactory, as leaving a doubt as to how far the strain may be carried with safety within the breaking strain; the increments of approach to this point cannot be estimated with safety; but it is eminently proper to regard that point in the loading as a safe one for the estimate of strains, within which, the material will, on being relieved of the strain, resume its original length within an inappreciable fraction; or, in other words, up to this point it is not strained or crippled. This point is what is known as the "limit of elasticity," below which the strains work no sensible injury to the material; and the term factor of safety, as applied to the margin of strength between the strains imposed and what would absolutely break the material, is of no consequence whatever.

From extended tests made by the engineers, the limit of elasticity in one of these cables is reached when it is strained to the extent of 8,118 tons, and the factor of safety derived from this estimate is 3.12; but this margin of strength differs from the factor of safety referred to the breaking weight, viz. 4.6, in that the cable may be loaded *up* to this point, without any injury whatever being apprehended. For instance, suppose the estimate of the live load for this span, viz., 1,311 tons, should prove too small, and the traffic should increase one-half, or a total of 1,966 tons. The proportion for one cable would be 492 tons, which, multiplied by 1.64 = 806 tons, which, added to 2,064, gives 2,770 tons as the strain on one cable, or a factor of safety referred to the elastic limit, of 2.92, or nearly 3.

If the traffic should increase to *double* the estimated weight (which is scarcely to be anticipated), the strain caused by it on a cable would be 1,075 tons, which, added to the strain caused by the weight of bridge as before, viz., 2,064, would be a strain of 3,139 tons on a cable, which can be strained with safety up to 8,118 tons, or a factor of safety by this comparison of 2.58; and, in fact, by pursuing this method of calculation, it will appear that *ten times* the estimated weight of traffic could be passed over the bridge and supposing no aid from the overflow stays whatever, yet the resultant strains on all the cables would be 2,700 tons within the limit at which the cables could be strained without any sensible injury.

We are well aware of the statements of scientists that there is no load, however small, that in time will not destroy the material subjected to it. Possibly this may be so, but so long as these savans are unable to compute the necessary time, or life of material under these circumstances, we are at liberty, in this practical age, to content ourselves with providing for a half-dozen generations or so, leaving remoter posterity somewhat indebted to us for the lesson which our blunders may have taught them.

CITY ENGINEERING IN PHILADELPHIA.

In a previous volume of this journal we described at some length the engineering department of Providence, R. I., and characterized it as the most complete organization of its kind in this country. It is the embodiment of simplicity—one department only, with one responsible individual as its head—a City Engineer appointed by the City Council, and by the city held responsible for the proper discharge of all the important duties resulting from the designing and execution of the public works under his charge. In this case it is expected

that the City Engineer is a well-qualified civil engineer, who knows more about sewer, bridge, water-works and street construction than the average ward politician; that he knows how to subdivide his duties and properly select his assistants for the several divisions over which his supervision extends, and that a man who can well and economically "run" the public works of even a moderately sized city is worth a fair salary, such as will warrant the imposition of so many responsibilities upon him that he will have no time to spare for political engineering, his works being the best recommendation that his employers can give their constituents.

As the antipodes of the simple, sensible, efficient and economical New England organization we are bound to record the complex, wasteful, bungling and inefficient system now in use in the second city of the Union, Philadelphia, and if we unwittingly are incorrect in any of our statements, or have drawn false conclusions, we stand ready to be corrected and will be thankful for the facts in the matter.

Philadelphia is governed by a mayor and two councils—the Common and Select. The Select Council is composed of thirty-one members, each one representing a ward of the city; the Common Council is composed of nearly one hundred members, elected *pro rata*, one to every 9,000 of the population. The public works of the city are managed by departments; they are Water, Surveys, Highways, Gas, Markets and City Property; there is also a Board of Health, a Board of Surveyors and a Board of Harbor Commissioners. The "Chief Engineer and Surveyor" of the city of Philadelphia, elected by joint councils for a term of five years, is the head of the Department of Surveys and President of the Board of Surveyors. His duties are the registration of property, the designing of bridges and sewers, the regulation of street lines and grades, and of harbor lines. Having prepared the design and specifications of public work, these are submitted to the "Board of Surveyors," consisting of the Chief Engineer and Surveyor and 13 District Surveyors, who meet on the first and third Monday of each month at the Chief Engineer's office, for the transaction of such business as may come before them. These surveyors are elected every five years *by the people* of their respective districts, and the nominees are seldom changed. Each one has a practical monopoly of the surveying business of his district, and is placed under bonds for the proper staking out of all private and public property, the highways, bridges, sewers and wharf lines. For the surveys and grades of public works, they are paid by the contractors; for those of private property by the owners thereof. After approval by this board, the contract is advertised and awarded by the Department of Highways, which is presided over by a "Chief Commissioner," who has no discretion in the matter of letting, but must award to the lowest bidder who is able to furnish security in one-half the estimated value of the work. The contract awarded in cases of large works of sewerage or bridges, the Department of Surveys notifies the contractor to begin work; the contractor then calls in the District Surveyor to give lines; during progress of construction of large works it is inspected by the engineers from the Department of Surveys, upon whose certificate estimates for payment are given; but the final estimate is made by the District Surveyor; the completed work is formally accepted by the Chief Engineer, the warrant is drawn by the Commissioner of Highways and ordered to be paid by the Mayor. All payments for highways, bridges and sewers are made by the Department of Highways. Sureties are held for three years. The building of small sewers is entirely under the superintendence of the Department of Highways, which also cleans and repairs all sewers and controls the street improvements, such as paving, curbing, etc., independent of any engineering department.

In this account of the clumsy shifting of responsibility, so that in case of failure "nobody is to blame," we are not certain that we have yet fully mastered the details; if any person of an investigating turn of mind will wrestle with the question of the comparative efficiency, economy and simplicity of Quaker engineering and that of other American cities, we will be pleased to record the results.

Here is the Engineering Corps, (Water and Gas Departments and District Surveyors excluded), of an American city of nearly one million of inhabitants: Chief Engineer, salary $3,600; Principal Assistant, in charge of designs, $1,800; Assistant Engineer, in charge of construction, $1,620; Draughtsman, $1,350; Registrar of Property, $1,350; Receiving Clerk, $1,350; 3 assistant clerks and 5 assistant registrars at $900 each, and 1 messenger. The offices are in the new city building and in appointments are second to none other in the country, with the exception of convenience and time-saving appliances, in which Providence must take the lead over all others.

The City Engineer of Providence has the highest salary of any official of that city; the list of his assistants is given on page 145, vol. 7, ENGINEERING NEWS. Of the 34 assistants there named nearly all are civil engineers, who can take a transit, level or chain and do duty in the field, or they can be equally efficient in the office. When the city of Providence wants a bridge or a sewer built it tells its Chief Engineer to build it, and that is all there is about it. There is no see-sawing about from City Engineer to independent Surveyors, to a Highway Commissioner, to contractors and so on back to the City Engineer. Will some one of our Philadelphia readers demonstrate for the general good the peculiar merits of the Philadelphia "plan" of city engineering and if it is susceptible of improvement, can such be effected, and how?

THE PREVENTION OF WASTE OF WATER.

In a paper read by Thomas Stewart, student Institution Civil Engineers, last April, and for which he received a Miller prize, we find descriptions of the methods resorted to by the authorities of many of the large cities of Great Britain in order to prevent the waste of water. Throughout the paper the term "waste" is applied to water which flows from defects in the service pipes and fittings (both material and workmanship being considered), but does not touch upon waste due to the prodigal use of water. The sources of waste are considered under the three heads: Defective water fitting, defective service pipes and defective distributing pipes.

The first division was the most fruitful source of waste, as the leaks were generally so located as to prevent inspection, and plumbers were in the habit of using fittings of inferior quality, deeming cheapness paramount to excellence, and except in the better regulated water-works this custom was general until within the past twenty-five years. The prescribing of the kinds of fittings and testing and stamping them are making great improvements in this matter, although much trouble is caused by the presence of old fittings, especially in places where there is no authority for compelling their removal. The defective fittings consisted chiefly of ground cocks and water closets supplied direct from the mains by taps. It was found that in a short time the cocks leaked, and at any time the water-closet taps allowed a continuous flow. In Glasgow they were prohibited shortly after 1860. During the summer of that year, the consumption rising at an extraordinary rate, a special inspection of the fittings in various parts of the town was made, and it was found that the common ball cocks were most wasteful; fifty-three of these being found wasting 12,500 gallons per day, and ninety-nine common cocks wasting 11,700 gallons. These investigations resulted in the following rules:

"That no common ground cock be allowed for the future to be supplied direct from the main service pipe, or from a cistern, except it be on the same floor as the tap, and that screw-down cocks only be used for this purpose."

"That no water closet be allowed to be supplied direct from the main service pipe, by any kind of tap, but be supplied from cisterns."

These rules, aided by a rigid house-to-house inspection, resulted in the saving of 5,000,000 gallons per day, or eleven gallons per head per day, and this rate continued until the Commissioners relaxed their exertions. During 1864 an examination was made of all the fittings to ascertain how many complied with the regulations, and it was found that forty-one per cent. of the whole were not in compliance, and every eighth tap was found wasting water.

The company at Norwich, acting under a special act of Parliament, reduced the consumption from 40 gallons per head per day to less than 14.5, the manager contributing one-half of this saving to the introduction of screw-down cocks, and the other half to the use of cisterns in place of cocks to water-closets and ground-ball cocks. By the same means Newcastle affected great saving; in one district, by the use of double-valve cisterns in each house, the consumption fell from 32.5 to 16.5 gallons per head per day.

Defective service pipes are not so numerous as defective fittings in proportion to the number of persons supplied; but the possibilities of locating the leaks are much fewer on account of the pipes being hidden. In Glasgow in 1876, of 10,825 complaints of deficient supply, 3,294 were found to be caused by bursted lead service pipes. The defects in lead pipes may result from want of sufficient strength to withstand the pressure, bad material, or inferior workmanship. It is difficult to unerringly detect bad material, owing to splits occuring upon the inside during manufacture. Iron pipes are generally subjected to a certain pressure before being used, and are laid under the superintendence of an officer of the water-works; while in some towns the corporation lay the pipe up to or through the walls. In increasing the supply to a town it frequently happens that the pressure is increased beyond the strength of the old service pipes, and unless there be some authority compelling their removal, the reduction of waste is much retarded.

Defects in distributing pipes are discovered by the water rising to the surface, or, when the waste is great, by lack of pressure in the immediate vicinity. Under certain conditions this waste may continue undetected for years, as shown by two cases in Glasgow where the water had burst the pipes and found a passage into the adjoining sewer, being revealed only by the falling in of the surface of the street.

In order to obtain proper service pipes and fittings, some towns keep samples to which all the materials must conform, and in addition approved fittings are tested and stamped. Cocks are subjected to a pressure about three times as great as they will have to stand when in service; water-closet cisterns are examined to ascertain if they give a flush of more than one and one half or two gallons within three or four seconds.

In 1868 double-valve cisterns were recommended for water-closets in Glasgow, and in 1873 cisterns were limited to not more than two gallons at a flush. When fittings were found wasting during the first two or three months they were removed; lead service pipe when found wasting twice during six months was removed if under ground or

in unoccupied cellars. Cocks supplied direct from the main were tested to 300 pounds; those for cisterns to 150 pounds; lavatory and other fittings to 25 pounds. The following table shows the improvement in the manufacture since the introduction of the system of testing and stamping:

YEAR.	Number Examined.	Number Rejected.	Per cent. Rejected.
1877	4,369	640	14.60
1878.....	26,931	1,710	6.30
1879.....	24,300	989	4.07
1880.	27,517	1,081	3.92

Service pipes of lead must be of the following weights per yard: ½-in., 7 lbs.; ¾-in., 10 lbs.; 1-in., 14 lbs.; 1¼-in., 18 lbs.; 1½-in., 24 lbs.

Cast-iron pipes must be as follows:

DIAMETER OF PIPE.	Thickness of pipe.	Depth of socket.	Length of pipe exclusive of socket.	Mean weight of each pipe.
Inches.	Inch.	Inches.	Feet.	Cwt. Qrs. Lbs.
4	⅜	3	9	1 1 25
3	⅜	3	9	1 0 17
2	⅜	3	6	0 2 4

We now come to the most important part of the paper, namely, that dealing with the

METHODS FOR DETECTING AND PREVENTING WASTE.

House-to-house inspection is in vogue in most of the larger towns in the kingdom, in some it being the only method, while in others it is used in conjunction with meters and other appliances. It consists in dividing the town into districts, appointing one inspector to each district, who inspect the premises and report any fittings that are wasting water. Notice is then served upon the tenant or owner. Within a certain time the premises are again examined, and if the repairs have not been made, water is shut off or the matter is reported to the Engineer. In Glasgow the second inspection takes place within six days of the first, and if the instructions have not been complied with the bad tap is locked up, or, when this cannot be done, the water is shut off at the stop-cock. It is not advisable in most cases to beat up the pipe leading to the tap on account of injury done to the building; but this is done when repairs are not made in a reasonable time. In 1873, in Glasgow, four inspectors were added to the force, making twelve in all, and the consumption was reduced 800,000 gallons per day as compared with the previous year.

To obviate the fact that house-to-house inspection does not localize the sources of waste, and to enable the worst districts to receive the most attention, meters have been placed on the distributing pipes supplying them. By this means—the population being known—it can be determined whether the consumption is above or below the average. The meters used for this purpose are of two kinds; those which register the quantity of water passed during a given period, and those which automatically—by means of diagrams—show the rate of consumption at any hour or part of an hour.

The paper contains quite an extended account of the Deacon system as applied to Liverpool, giving the results obtained. As this system has been fully described in our columns, we omit a review.

It has been proven that the waste from defective pipes and fittings is much greater at night than day on account of the increased pressure,* to obviate which pressure-reducing valves are so placed that the pressure on the distributing pipes will be lessened. In Glasgow the ordinary variations of pressure in the mains are from 40 pounds per square inch during the day to 85 pounds at night. The valve in one district was so adjusted that the pressure would at no time exceed 45 pounds, and the saving amounted to 12,000 gallons, or 4.25 gallons per head per day from 4 p. m. to 8 a. m. The night rate per head per day before the valve was fixed was 24.7 gallons; afterward it was 15 gallons, showing a saving of 9.7.

In concluding, the author states that each of the three systems for detecting and preventing waste—house-to-house inspection, district meters, and reducing valves—has its own applications, and neither is perfect alone, but becomes more nearly so when combined with either of the others.

The first has been found to reduce the waste to its lowest limits, but at an outlay of energy and money which few towns can afford; but it fails to detect obscure (such as underground) cases.

District meters locate the place where most waste occurs, show the locality of a leak and the saving of water effected.

Pressure-reducing valves deserve more attention than they receive. By reducing the pressure in low districts an increase will be made to those more elevated.

In closing, the author says:

"In estimating the various methods for preventing waste regard is had to the expense, and as this is the only matter on which corporations and water companies venture to decide what shall be done it is natural that at first they should select that which appears least expensive. Owing to house-to-house inspection sometimes giving good results, it is usually preferred, but the degrees of success which attend it are extremely various, and in no case can it be effective unless stringently carried out."

* [Water under a head sufficient for fire purposes will escape from a hole one one-hundreth of an inch in diameter at the rate of more than a barrel in 24 hours, and from a pin hole more than 200 gallons will flow during the same time. —ED.]

PERSONAL.

W. P. Harris, Superintendent of the New York & Greenwood Lake Railroad, has resigned and become a Division Superintendent on the Chesapeake & Ohio road. J. H. Tenney, Assistant Superintendent of the New York & Greenwood road, has been appointed in place of Mr. Harris.

Dr. Stroussberg, the once famous railway king and bankrupt, has been busy in retrieving his shattered fortunes with street railways and cheap newspapers in Berlin, and has regained the confidence of capitalists, which he seemed never to have entirely forfeited. His latest enterprise aims at the construction of the long planned Euphrates railway.

The *Two Republics*, published in the City of Mexico, contains the following upon the subject of engineer's salaries: "As regards Mexico, we do not think engineers receive salaries here double those paid in the United States. On the railroads being constructed under Mexican management native engineers are generally employed, and we are informed that their salaries are less than what would be earned in the same positions in the United States when the difference in the value of money is taken into consideration. On the railroads being built by American companies the salaries are about the same as those paid in the United States. We do not think the inconveniences of living are greater here than they are in the new and thinly-settled portions of the United States, and when the climate and the few temptations there are here to spend money are considered we feel safe in saying that with equal salaries engineers can save more money in Mexico than in the United States. It is not supposed that men employed constructing railroads in any new country can have all the amusement and creature comforts that might be desired. Engineers have to rough it in the United States just as they do here. In the cities pleasures and comforts can be had in both countries, but these are not to be enjoyed to any considerable extent in the prairies or forests of either."

A number of Canadians, distinguished in the civic and railway affairs of the Province of Quebec, arrived in this city a few days ago in a new special car. The visitors, who are J. A. Chapleau, Premier of the Province of Quebec; E. T. Paquet, Secretary of the Province; L. A. Senecal, General Superintendent of the Province of Quebec Railway; J. B. Labelle, General Passenger Agent; A. Louthood, Secretary and Chief Accountant, and A. Davis, Mechanical Superintendent—have come mainly for rest and recreation, but the railway officials have taken the opportunity to transact a certain amount of business. They came to this city in a new palace car built for the official coach of the Province of Quebec Railway. The car is a model of beauty and comfort. It is 70 feet long, 10¼ feet wide, and 13 feet high. The exterior is painted in olive, ornamented with gold and claret. The interior is divided into three compartments—parlor, kitchen, and a sleeping-room, the kitchen being in the middle. The sides are finished with panels of black walnut, cherry, bird's-eye maple, and other ornamental woods. The ceiling is frescoed in blue, red and gold, and the corners are relieved by medallions in oil colors. A rich Axminster carpet covers the floor, and the windows and doors are curtained with brownish-gray tapestry, to match the upholstering of the Queen Anne furniture. Under the kitchen is a compartment for carrying provisions, fuel, etc. The car is supported by two trucks, each running on six steel wheels about three feet in diameter. The wheels are made after a new design of Mr. Davis, the Mechanical Superintendent of the Province of Quebec Railway, who built the car, and are riveted sectionally so that a break in any one part of the wheel will not disable the other parts.

A NEW WATER METER.

In September last a company was incorporated under the general laws of the State of New Hampshire for the purpose of manufacturing the Howe water meter. Its capital stock is $400,000, divided into 40,000 shares of $10 each, and the sole ownership to the patent of C. H. Bacon, of Boston, was purchased; thus the company acquired an undisputed title to the invention. Where a record of the minutest quantity of water used is required, it is claimed that the "Howe" is unequaled, and that it combines all the essentials necessary to a machine to satisfactorily register the consumption of water. From this cut a good idea of the construction and mode of working the meter can be obtained. Two cast-iron cylinders are placed in the form of a V joined at the bottom and arranged to oscillate on their common base, as the quicksilver contained therein causes the center of gravity of the two cylinders to change. The oscillation opens to one cylinder the ports of the supply pipe, and simultaneously shuts those to the other. The same effect is produced in

the return movement. The water from the supply pipe rushes in at the open port, forces the quicksilver from that cylinder into the other, when the center of gravity changes, and the two cylinders again oscillate, and the ports are inversely opened and shut. The cylinders oscillate about twenty degrees, and with each change is registered on a dial the amount of water which the two cylinders contain. The meter has no friction, except that of the quicksilver flowing over iron, and that occasioned by its oscillations of 20° on a composition pivot. It has no valves or nicely fitted joints, consequently the chances of getting out of repair are lessened. The Howe meter acts on the piston principle, but does not meet with the wear and tear caused by the friction of a piston, working backward and forward against a strong head of water and continually coming in contact with the particles of grit and dirt the water contains, because the quicksilver, which is the piston, adjusts itself to the cylinders. The chances for leakage are reduced to a minimum, as waterways and the absence of valves permit the passage of foreign substances which so frequently cause other piston meters to get out of order. It is claimed that the meter can be constructed and furnished cheaper than any other meter in the market, as the principal cost is quicksilver which does not depreciate with use. Registration under a small pressure is another important feature of "Howe," while its construction is so simple that it is expected the meter will soon come into general use. Through the courtesy of Mr Bacon, superintendent of the company, we are enabled to furnish these particulars of his invention.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 503.)

CLVII.—PORT HURON.

Port Huron, Michigan, in lat. 43° N., long. 82° 30′ W., is on the St. Clair River at the mouth of Black River, one mile from Lake Huron. Settled in 1828, it was incorporated as a city in 1859. In 1873 water-works were built by the city after the plans of William H. Avery, C. E., taking water from the St. Clair River and pumping directly into the mains by Holly steam pumps. A small Perkins pump was added in 1880. The ordinary pressure maintained is 30 lbs. per square inch, and the fire pressure 65 to 110 lbs. The first distribution pipes laid were of cast iron. Since 1879 Wyckoff wood pipe has been used for extensions. Nineteen miles of mains are now in use of from 16 in. to 3 in. diameter, with 109 fire hydrants, 230 gates and 1,037 taps. Lead service pipe is used.

The population in 1880 was 10,000, and the daily consumption 500,254 gallons.

The works have cost $180,000. The bonded debt is $150,000, bearing 10 per cent. interest.

The expenses in 1880 were $5,982.32 and the receipts $9,080.12.

The works are managed by three water commissioners. William H. Avery has been the Chief Engineer since 1873, and was Superintendent from 1877 to 1881.

Lewis Atkins has been Secretary since 1873 and is now the Superintendent also.

CLVIII.—LINCOLN.

Lincoln, Massachusetts, in lat. 42° 23′ N., long. 71° 14′ W., is 14 miles N. W. of Boston, in a hilly, agricultural region. It was settled in 1747, and incorporated as a village in 1754.

In 1875 water-works were built by the town, after the plans and under the superintendence of Marshall M. Tidd, C. E. The supply is taken from Sandy Pond, a natural lake of 152 acres area, and lifted by a Worthington duplex pump of 312,000 gallons capacity per day, through 6 and 8-in. pipe, into a reservoir built in excavation and embankment, and holding 130,000 gallons.

Distribution is by wrought-iron and cement pipe, of which 3½ miles are in use, with 11 fire hydrants and 23 taps.

The population in 1880 was 907. The consumption is not known.

The works cost $33,000, and there is a bonded debt of $30,000. The annual cost of maintenance is about $500. The works were made over to the water takers to run for their own use and pay their own expenses, and they are so operated, the water takers dividing the cost of operation, which amounts to about $10 per annum for each faucet. J. L. Chapin has been the Superintendent from the beginning.

CLIX.—MEMPHIS.

Memphis, Tennessee, in lat. 35° 8′ N., long. 90° 3′ W., is on the Mississippi River, just below the mouth of Wolf River. The city stands on the fourth Chickasaw Bluff, about 35 ft. above the highest floods. The ground falls from the summit ridge to the Mississippi on one side and the Bayou Gayoso on the other.

It was laid out in 1820, and incorporated as a city in 1827.

In 1872 water-works were built by a private company, with A. R. Ketcham as Consulting Engineer, and Galen W. Pearsons, C. E., as Constructing Engineer, taking water from Wolf River, 2 miles north of the centre of the city. At the foot of the bluff, two rows of oak piles, 12 to 14 in. in diameter and 30 ft. long, were driven 18 ft. into the ground, for 150 ft. along the river. The rows were 8 ft. apart and the piles 4 ft. apart in the rows. They were connected by longitudinal timbers, along which 5-in. sheet-piling was driven. Outside of this, a well 18 ft. in diameter, with 21-in. brick walls on a timber shoe, was sunk 23 ft. by excavating from the inside and setting the curb through gravel and quicksand, very difficult to handle. A filtering trench was formed between the sheet-piling, 3½ ft. wide and 4 ft. high, with brick side-walls and plank top and bottom, and covered with 5 ft. of gravel. A crib of timber, 60 ft. wide, was extended into Wolf River and filled with gravel, and covered with plank and gravel.

From the outer wall and gravel crib a tunnel, 130 ft. long and 12 ft. below low-water mark, was run into the bluff to a plate-iron well 18 ft. in diameter and 60 ft. long, extending down from the surface. The excavation was made 24 ft. in diameter for 30 feet down and then reduced to 15 ft. diameter and carried down with sloping sides for 16 ft., being then 10 ft. in diameter. The iron tube was then built up on the shelf and suspended by screw rods from a truss overhead and lowered by them as successive plates were added to the top.

Eight pumps of 20-in. diameter and 24-in. stroke placed in the bottom of the well, and drawing water through a 20-in. pipe laid in the tunnel to the outer well and crib, forced the water directly into the mains. The pump rods extended to the top of the well and were there operated by cranks on a shaft geared to a Holly engine with two cylinders of 21-in. diameter and 33-in. stroke. Two rotary pumps at the ground level took their supply, when they were needed for fire service, from a reservoir of 3,000,000 gallons capacity, built near the engine house and filtered from the other pumps.

The company laid 17 miles of pipe at that time, the entire works costing $473,278.39. The supply furnished by the company was not satisfactory as to quantity or quality, the filtering apparatus proving ineffective and the machinery insufficient. In 1880 a new company was organized, which purchased the existing works for $200,000 and reconstructed them.

A 24-in. pipe extends from the river through a tunnel 200 ft. long, to a brick well 18 ft. in diameter and 61 ft. deep, resting on a cast-iron shoe. At the bottom of the well are four double-acting plunger pumps of 16-in. diameter and 36-in. stroke, with connecting rods extending to the top of the well, to two pairs of steam cylinders of 24-in. diameter and 36-in. stroke, the piston rods of each pair being connected to cranks on a fly-wheel shaft. The engines are after the designs of H. F. Gaskill, and were built by the Holly Manufacturing Company. There is an air chamber on the suction pipe, and one on each discharge pipe. The engines pump directly into the mains.

Distribution is by cast-iron pipe, of which about 20 miles are laid, with 200 fire hydrants, 3,000 taps and a few meters.

The population in 1880 was 33,593, and the daily consumption was stated to be 5,000,000 gallons.

The capital stock of the company is $350,000 and the bonded debt $100,000, bearing 6 per cent. interest. The expenses for maintenance in 1880 were about $25,000 and the receipts $45,000. Water is furnished to the city for public buildings and for fire purposes without charge.

T. J. Latham is the President and W. L. Cameron Secretary of the company.

CLX.—SALT LAKE CITY.

Salt Lake City, Utah, in lat. 40° 46′ 2″ N., long. 111° 50′ 37″ W., on the Jordan River, 4,320 ft. above the sea, is at the eastern base of the Wahsatch Mountains near a point that projects into Salt Lake valley. A portion of the city is built on the mountain bench, the remainder on a nearly level plain. It was settled in 1847 and incorporated as a city in 1851. The streets are all 132 ft. wide and are at right angles to each other, making uniform blocks of ten acres area each.

Water-works were built by the city in 1874, after the plans of Thomas W. Ellerbeck. Water is taken from City Creek, a cañon stream north of the city, with 30 square miles water-shed, and fed by mountain springs and melting snow. The stream supplies irrigating water during the summer for the greater part of the city, a current of water being carried along the gutter on each side of the street. A timber dam across the creek diverts its waters into a flume of redwood, 2½ by 4½ ft. and 100 ft. long, leading to two tanks, one 29½ by 16 ft., the other 28 by 15½ ft., both being 10 ft. deep. These tanks are 180 ft. above the northern part of the city and 225 feet above the southern and western portions. The actual pressure in the pipes is 70.01 lbs. per square inch.

Distribution is by cast-iron pipe, of which 11 miles are laid, of from 20 to 4-in. diameter, with 128 fire hydrants. The number of the taps is not furnished.

The population in 1880 was 20,768, and the daily consumption is estimated at 250,000 gallons. The works have cost $250,000. The total receipts to date have been $33,892.35. The expenditures in 1880 were $20,902.73, and the receipts $8,509.60. The works are managed by the city council and a superintendent. The latter position has been filled by T. W. Ellerbeck, F. Little and the present incumbent, G. U. Ottinger.

CLXI.—WALTHAM.

Waltham, Massachusetts, on the Charles River, ten miles west of Boston, is principally on one street a mile long, in a level plain of about 2½ square miles area, surrounded by high, wooded hills. The river affords water power for manufacturing purposes. The first cotton mill was erected there in 1814. The town was incorporated in 1838.

Water-works were built by the town in 1873, after the plans of Edward Sawyer, C. E., and under the superintendence of Joseph H. Curtis, C.

*Copyright 1881.

E., taking the supply from a basin 8 ft. deep, on the bank of the Charles River, constructed by making an excavation into a gravel knoll on one side, and on the other three sides, inclosing a portion of the river, by a coarse gravel embankment some 60 ft. in width. During the construction of this basin it was necessary to pump the inflowing water at the rate of 4,000 gallons per minute. The natural level of the water in the basin is slightly above that of the river, and its temperature is more uniform throughout the year. Experiments made by Prof. W. R. Nichols in 1876 led to the conclusion that a greater portion of the yield came from the ground water than from the river by percolation through the gravel.

A conduit 65 ft. long conveys the water from the basin to a pump-well, whence it is pumped by two Worthington compound engines, with high-pressure steam cylinders of 14-in., low pressure 30-in., and water cylinders 14-in. diameter, all of 18-in. stroke. One engine was erected in 1873 and the other in 1880. They deliver into a reservoir 230 by 280 ft., with semicircular ends, built in excavation and embankment, 165 ft. above the pumps and 138 ft. above the highest street level. Distribution is principally by wrought-iron and cement pipe. Recent extensions are of cast-iron pipe. Some trouble has been experienced with the former pipe of 4-in. and 6-in. diameters. There are 23.33 miles of pipe in use, of from 16-in. to 4-in. diameter, with a few short lines of 2-in. cast-iron. There are 130 fire hydrants, for which the town pays $25 per annum each. The number of taps is not furnished. Eight meters are in use.

The population in 1880 was 11,711 and the daily consumption 411,000 gallons.

The works cost to Jan. 1, 1881, $305,722.13.

The expenditures in 1880 were for interest $20,119 and for maintenance $4,984.39. The receipts were $25,132.86.

The works are managed by three water commissioners, one of whom is elected annually.

The Superintendent is C. F. Parks.

CLXII.—DECATUR.

Decatur, Illinois, in lat. 39° 45′ N., long. 89° W., is on the right bank of the Sangamon River in a flat bottom land, the soil of which is underlaid with gravel.

In 1871 water-works were built by the town, under the superintendence of Kinsey and Mahler, civil engineers, taking water from the Sangamon River, and pumping directly into the mains by two Cameron pumps with steam cylinders of 18-in. and water cylinders of 12-in. diameter. A Holly rotary pump aids in obtaining fire pressure.

A 22-in pipe conveyed the water from the river to the pump well. Afterwards a crib was sunk 600 ft. long. 10 ft. wide and 6 ft. high and arched over, into which the surrounding water filters, and is led to the pump well. A pipe connects with the river, but is used only in very dry seasons.

Distribution is by cast-iron pipe, of which 97 miles are in use, with 100 fire hydrants and 385 taps.

The population in 1880 was 9,449 and the daily consumption 250,000 gallons.

The works have cost $145,000. The annual cost of maintenance is $5,000.

Sullivan Burgess was the Superintendent and Engineer from 1871 to 1880. The City Clerk, G. P. Hardy, and Superintendent of streets now attend to the management of the water-works.

CLXIII.—LOCKPORT.

Lockport, New York, in lat. 43° 12′ N., long. 78° 50′ W., is on the Erie Canal, 20 miles east of Niagara Falls, in a precipitous limestone region. The canal here descends 60 ft. by five locks in succession. There is a flow of 35,000 cu. ft. per minute in the canal, one-fifth of which is used for navigation, and the remainder is utilized for water power. The city is on two planes, the lower nearly level, the upper 62 ft. above it, and rising slightly back from the bluff. The city was incorporated in 1865. Water-works were built in 1868 by the Holly Manufacturing Company, taking the supply from the canal above the locks, pumping directly into the mains by four double-acting pumps, driven by water power, under 52 ft. head. The water for power and supply is led to the wheels and pumps through a tunnel 500 ft. long through rock. Its dimensions are 9 by 10 ft. The ordinary pressure maintained is 100 lbs. per square inch; fire pressure, 150 lbs.

Distribution is by cast-iron pipe. Flanged pipe was first laid, since replaced by the ordinary form of hub and spigot pipe. Seven miles are in use, of from 12-in. to 4-in. diameter with 133 fire hydrants, 36 gates and 250 taps.

Service pipes are of wrought-iron gas-pipe. The population in 1880 was 13,522 and the daily consumption about 800,000 gallons. The Holly Manufacturing Company own and operate the machinery, the city furnishing the pipes and hydrants. No statement of cost, receipts or expenses is furnished. H. F. Gaskill is the superintendent of the company.

CLXIV.—IRONTON.

Ironton, Ohio, in lat. 38° 40′ N., long. 82° 30′ W., is on the Ohio River, in the centre of the Hanging-rock iron region. The city is on a high bluff, and at the foot of lofty hills. Settled in 1849, it was incorporated as a village in 1852 and as a city in 1865.

Water-works were built by the town in 1870, on the plans of the Holly Manufacturing Company, taking the supply from the Ohio River and pumping directly into the mains by 6 single-acting pumps of 14-in. bore and 18-in. stroke, operated by a Holly engine and 2 rotary pumps for fire pressure. The highest point supplied is 85 ft. above the river. An ordinary pressure of 30 lbs. per square inch is maintained and a fire pressure of 80 lbs.

Distribution is by cast-iron pipe of from 12-in. to 4-in. diameter; 8 miles are in use, with 114 fire hydrants. The number of taps is not given.

The population in 1880 was 9,000 and the daily consumption 1,500,000 gallons.

The works have cost $160,000. The expenses in 1880 were $7,500 and the receipts $10,000.

The works are managed by three trustees. Edward Lawton is the Superintendent.

CLXV.—WINSTED.

Winsted, Connecticut, in lat. 41° 55′ N., long. 73° 7′ W., on Mad River, comprises two villages connected by a winding street three miles long following the river, along which the business portion of the town is built, the residences generally occupying the hill-sides farther back. It was settled in 1770. In 1861 water-works were built by the borough of Winsted, after the plans of A. Chamberlain, taking the supply from two natural lakes, one of 390 acres area, increased to 500 acres by a dam 4 ft. high, the other of 100 acres area. The dam is of earth. In 1874, two waste-weirs of masonry, with concrete overflow, were built. From the lake, which is 220 ft. above the lowest portion of the town, the water is conveyed by 1,760 ft. of wrought-iron and cement pipe, and 880 ft. of cast-iron pipe, to the distribution, which comprises about 10 miles of pipe, half of which is of wrought-iron and cement and half of cast-iron pipe. There are 85 fire hydrants. The number of taps is not accurately known.

The population in 1880 was 4,500. The consumption is not stated.

The works have cost $100,000. The outstanding bonded indebtedness on May 1, 1881, was $25,000.

The receipts and expenses for five years past have been as follows (the years ending April 20):

	1877.	1878.	1879.	1880.	1881.
Receipts	$3,866.36	$4,467.94	$4,485.23	$4,490.72	$4,704.94
Expenses of maintenance.	2,044.90	3,931.59	3,010.01	1,064.64	2,666.47

The annual interest on the bonds is $1,500 additional.

The works are managed by three water commissioners, one of whom is elected annually. Henry Hungerford Drake is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks:

From G. P. Hardy, City Clerk, statistics and rates of Decatur (Ill.) Water-works. From G. M. Ottinger, Superintendent, statistics of Salt Lake City Water-works and water rates. From Edward Lawton, Superintendent, statistics of Ironton (O.) Water-works. From C. F. Parks, statistics of Waltham (Mass.) Water-works. From H. Hungerford Drake, statistics, water-rates, and annual reports for 1877 to 1881, of West Winstead (Conn.) Water-works. From T. J. Latham, President, history, statistics, charter and water rates of Memphis (Tenn.) Water-works. From H. F. Gaskill, Superintendent Holly Manufacturing Co., statistics of Lockport (N. Y.) Water-works. From Thomas W. Baldwin, City Engineer, a full set of Reports of the Bangor (Me.) Water Board for 1877 to 1881.

From Edward S. Frost, Secretary and Treasurer, Statistics and Water Rates of the Akron, Ohio, Water-Works Company; from an anonymous source, History of Bridgetown, N. J., Water-Works; from J. L. Chapin, Superintendent, Statistics of Lincoln, Mass., Water-Works; from the Superintendent, James Wyatt, Statistics of Nashville, Tenn., Water-Works; from C. Baillargè City Engineer, History of Quebec, Canada, Water-Works, and Reports of G. R. Baldwin, 1848, T. C. Keefer, 1860, G. R. Baldwin, 1865, and C. Baillargè, 1881, on the Water Supply; from H. W. Lake, Secretary, Statistics of Leadville, Colorado, Water-Works; from W. H. Avery, C. E., Statistics of Port Huron, Michigan, Water-Works.

CORRESPONDENCE.

CALCULATION OF EARTHWORK.

San Miguel, Mex., Nov. 12.

Editor Engineering News:

I desire to call the attention of your readers to a matter of calculating earthwork.

Take, for example, the problem given in Henck's field book, page 103. Here we have a section of the following dimensions: Length, 100 feet, width of road-bed, 18 feet, with side-slopes 1½ to 1. One end area has a center height of 13.6 feet; right side height 10.0, and distance out 24 feet; left side height, 8.0 feet, and distance out 21 feet; area is 387 square feet. The other end area has a center height of 8.0 feet; right side height 12 feet, distance out 27 feet; left side height 4 feet, distance out 15 feet; area is 240 square feet.

According to Mr. Henck's formula, he finds the contents to be 32,820 cubic feet. On page 110 he states that if the diagonal were reversed (am I to understand by that, if one of the areas were reversed) the contents would be 29,600.

Now let us calculate this same section by the prismoidal formula. A center area would have a center height of 10.8 feet; right side height 11 feet, distance out 25.5 feet; left side height 6 feet, distance out 18 feet, area 311.4. Without giving process of calculation, I find contents to be 31,210 cubic feet.

Now, the singular part is, if the average of Mr. Henck's two calculations be taken, it gives precisely the same result, thus: 32,820 + 29,600 = 62,420, divided by two equals 31,210.

Now, I desire to know which is correct, and why. This is a matter of importance, as a differ-

ence of 1,610 cubic feet is no small item, and would amount to considerable in a long distance.

Yours truly, FRANCISCO CHAVEZ.

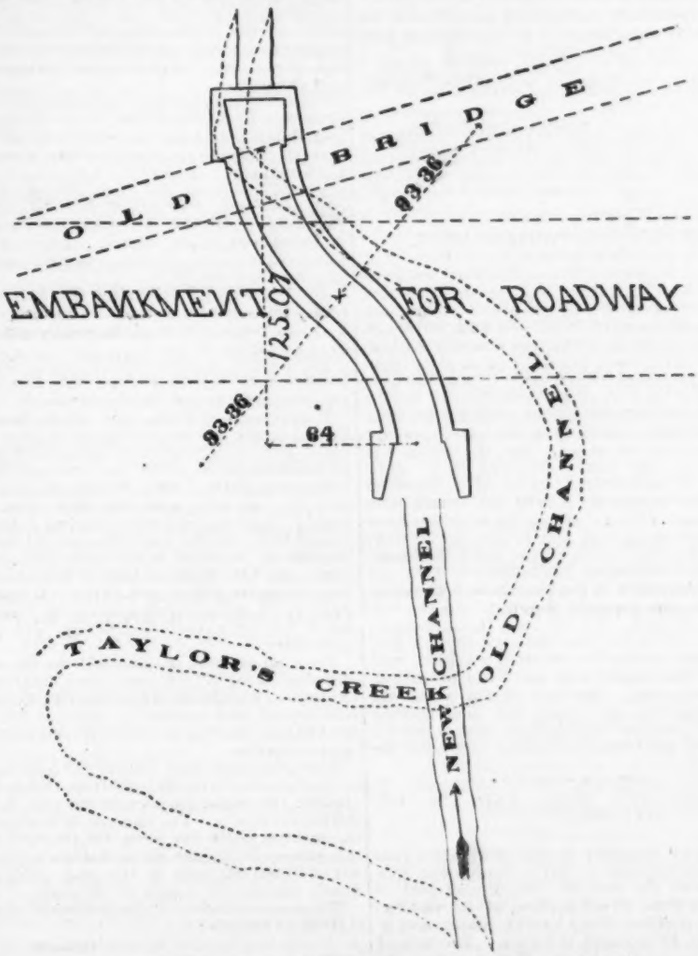
A REVERSE CURVE INSTEAD OF A SKEW ARCH.

NEWPORT, Ky., Nov. 29, 1881.

EDITOR ENGINEERING NEWS:

Accompanying I send a sketch of the foundations of an 18-ft. arched culvert which I designed and constructed near here several years ago.

The only peculiarity of the design is the method of obviating the necessity for a skew arch by means of a reversed curve.



A REVERSE CURVE INSTEAD OF A SKEW ARCH.

The banks of the creek being high and abrupt necessitated the location as shown; a straight line connecting the two ends, making an angle of 62° 54′ with the axis of the road, the skew being 64 ft. in 125.07.

The work was constructed with ordinary limestone rubble work in cement.

The appearance inside the culvert is very singular, there being no straight lines.

I believe the plan has the merit of novelty; at least I have never seen or read of a precedent. With the hope that the idea may possibly be of utility elsewhere, under similar conditions, I send it. Respectfully, B. R. MORTON, C. E.

ENGINEERING IN MEXICO.

IN CAMP, near Rancho Colorado, Nov. 21, 1881.

EDITOR ENGINEERING NEWS:

Noticing the many complaints of engineers engaged on Mexican railways, about the irregularity attending the arrival of ENGINEERING NEWS, I am glad to say I have not missed one single number since arriving here in April last. My headquarters have been on a constant move, and most of the time in the wildest parts of the Sierra Madre, but ENGINEERING NEWS has always found its way to me and been a source of pleasure, while other papers remained away. Of course I do not intend to pay a tribute to the alacrity of the Mexican mail service. In a country where people depend for rapid transit and the carrying of freight almost wholly upon the uncertain disposition of an inferior class of mules, one cannot expect to hear from the outside world promptly. But this company (the Mexican Central) has its own carriers and the mails are distributed by them directly after being landed at Tampico.

The more we learn of Mexican life and customs the more marked seems the difference with other civilized countries. It is certainly strange that Mexico, being the first discovered, should be the last in civilization, progress and spirit of enterprise of all America. Our present invasion, peaceful though it is, will cause a great change in the internal affairs of Mexico. The abominable land system of lords and tenants, not a particle better than in Ireland, will have to be abolished from the start, and the inadequate way of taxation will likewise undergo a complete change. The country must be thrown open to immigration, and immigrants will come and settle in this genial climate as soon as the land-owners show a more liberal disposition to sell parts of their property; at present this disposition is decidedly the other way; enormous estates exist, many covering hundreds of square miles of territory of idle soil that might be tilled, but those who own, hold on to what they have, and all look forward to enriching themselves without knowing exactly how it is to be done but by profiting from the railroads.

Much has been said and written about Mexico; much that is true and more that is false. But great as is the capital so generously pouring in upon this country, it is not half sufficient to open up the numerous hidden resources of which history has kept a record since the days of the Montezumas. We only have to realize that here we are still a century behind and be moderate with our appliances at modernizing. The people are not inimical to our enterprises, though they may view them with suspicion; but the report which has generally gone abroad, that they are more or less of the cut-throat pattern, is altogether wrong. I was surprised to find them peaceable, honest, open-hearted and hospitable.

I would gladly write you more fully, but our busy life leaves but few moments of leisure. I have been locating the line through the ragged parts of the Sierra Madre, using 2½ per cent. maximum grade and 15° minimum curve for 25 meter chords. I am now on the western slope of the Sierra, running a preliminary toward Valle del Maig, with a view of improving on the location.

Very truly, MAX E. SCHMIDT, C. E.

SANITARY INSTITUTE OF GREAT BRITAIN.

At an examination held by the Sanitary Institute of Great Britain, on Nov. 3 and 4, eight candidates presented themselves. The Institute's Certificate of Competency as Local Surveyors was not awarded, but the Institute's Certificate of Competency as Inspectors of Nuisances was awarded.

The following questions were set to be answered in writing on the 3d, and the candidates were examined *viva voce* on the 4th:

SURVEYORS.

State the conditions under which the discharge of sewage matter into streams is prohibited by the Rivers Pollution Prevention Act, and also the conditions under which such discharge is not prohibited by this act. Explain what is the meaning of a "stream" under this act.

Is foul air more likely to be found in the sewers of a town or of a village? and why? What are the best means of preventing its formation?

What are the relative advantages and disadvantages of pipe and brick sewers? How can the objections to pipe sewers be overcome? Illustrate your answer by sketches.

How much sewage would pass in twenty-four hours through a sewer of 8-in. diameter, laid at an inclination which would give a velocity of 3 ft. per second, and what population would this sewer suffice for in a town with a public water supply where the rain and surface water, other than that from the roofs and paved yards of houses, is carried off by a separate system? Give your calculation in full.

Draw the scheme of drainage you would suggest on the accompanying plan of a dwelling-house, and give sketches of the various traps you would employ, of the method of laying the drain, and of its connection with the sewer, accompanied by a short description of the mode of executing the work you propose.

If asked to advise as to the water supply of a town, what are the chief points to which you would direct your attention, if the supply is to be derived (*a*) from wells, (*b*) from streams?

Describe the construction of an ordinary rain gauge and the precautions which should be taken in fixing it. Give instances of the amount of annual rainfall in various places. What weight of water does one inch of rain on an acre represent?

What materials are used for the construction of cisterns and water pipes, and what are the advantages and disadvantages of each?

Explain what is meant by ventilation of rooms. How far does the size of a room affect the question? Given a room 12 ft. by 10 ft. by 10 ft. high, occupied by three persons, what means of ventilation would you adopt? To what extent will they be efficient?

Write a specification for the construction of a macadamized road, 40 ft. wide with 6 ft. footway on each side, across an estate on a clay soil, with cross section, and estimate of cost per foot run.

INSPECTORS.

Mention the principal acts relating to the public

health, and state briefly their most important provisions.

What is the order of procedure prescribed by the Sale of Food and Drugs Act in obtaining for analysis samples of articles suspected of being adulterated?

Describe some simple means of ventilating sleeping-rooms which you think would be efficient. What do you consider overcrowding?

What are the physical characteristics of good drinking water?

A house is found to be unhealthy, there are occasionally (not always) offensive smells, perceived both in the basement and in the upper rooms; what is the most likely cause of this, and how would you proceed to investigate it?

How should the soil pipes, sink pipes and overflow pipes of a dwelling be dealt with so as to prevent any danger to the inmates? What do you consider a proper fall for a 6-in. house drain?

How would you proceed to disinfect a house in which a case of typhus fever or small-pox had occurred?

In the inspection of a slaughter-house, to what points would you specially direct your attention? What are the requirements of a properly-constructed slaughter-house?

ANNUAL REPORT OF THE CITY OF DENVER, COL.

On a prospective change in the office of city engineer, the late incumbent states as follows:

It will perhaps be recognized by all, from what I have called to mind, that the duties of your city engineer in the future cannot be otherwise than onerous and responsible. Not knowing at this time who he may be, I bespeak for him the same generous good will and support you have given me.

One thing especially I would call to your notice. In this office, above all others in your gift, frequent changes should be avoided, and in the shortness of the term prescribed lies the danger of incompetency securing the position.

The work requires skill and engineering talent to a considerable degree, yet few professional men care to be subjected to the chances of yearly elections, and abide, too often without regard to their qualifications, the decisions of political caucuses.

My immediate recommendations to your honorable body are as follows:

As to the City Engineer's office, make up your mind that the public engineering of a city of 50,000 inhabitants, growing as is Denver, can no longer reasonably be expected to be so nearly self-sustaining as to cost the city no more than four or five thousand dollars per annum with economical results. The work of the city now crowds the office. Much work is left undone that should be done. Another clerk and a draughtsman can be constantly employed with profit to the city.

Strict police surveillance should be held over all excavations in the thoroughfares, and no longer should be enacted the farce of putting the engineer's office to vast labor and considerable expense in issuing permits to excavate in streets under strict rules that the police fail to enforce.

Here, again, is large work for the engineer to keep record of all pipes or other construction placed in the streets. Else what knowledge has the city government of what occupies its thoroughfares, or what barriers to some future improvements of great public necessity may be entailed by the indiscriminate occupation of the ground. Pipes for all uses and without regard to plan or system, heretofore, and until the year just past, have been freely placed in the streets of this city.

This task alone demands the entire time of one assistant.

The sewers must not be left to themselves. In the great rush of work which crowds every branch of the engineering department no systematic flushing of the sewers has been followed. Our sewer system is indeed constructed with special reference to this end, and I have designed a flush valve for use in the flushing cisterns, but beyond determining the fact that it can be made to work, and undoubtedly with excellent effect, the construction of the valves has been for the time overlooked.

The flushing of the sewers should be no longer delayed, however, nor regular inspections of the various laterals now in operation, and it is my recommendation that pending the completion of the flushing tanks, every lateral to be flushed at least once every two days by water from a portable tank. New sewer districts should also be formed at once and the drainage work extended. Our iron bridges should also receive attention and consideration.

If I have succeeded in giving any satisfaction under the responsibilities which of late have divided my time and prevented my giving much of my personal service to the city, it must of necessity follow that it is largely due to the able assistance I have had. This I desire to acknowledge and return thanks for.

Mr. H. F. Merryweather, C. E., has been an able and most industrious assistant in general charge. Mr. J. B. Hunter has been an invaluable aid in field service. Mr. Wilcox, as chief of sewer-inspectors, has been attentive and vigilant, as indeed have all the other employés, as I believe. I hope that such of them as desire it will be retained in the service under my successor, and indeed I imagine that for some time, at least, that will be found almost a necessity. Very respectfully submitted,

H. C. Lowrie, City Engineer.

We commend what Mr. Lowrie says on the changes of city officers as worthy of consideration in towns of growing population. The condition of the sewers in Denver City in the early future may be imagined if designed and carried out by the method here stated.

SLOW-BURNING CONSTRUCTION.

So long as wood must be used for floors and roofs there can be no such thing as fire-proof buildings. It is therefore proposed by one of the leading fire insurance companies that all new structures, and particularly factories and shops where wood is to be used, shall be made fire-resisting or slow-burning. The plan suggested is worthy of attention, because it often happens that, if the fire can only be confined to the interior of the building for even a few minutes, much property, and perhaps many lives, can be saved. For the floors it is proposed to use heavy timbers 30.5 centimeters by 30 centimeters (12 by 14 in.), and on these to lay matched planks 7.6 centimeters (3 inches) thick. Over these planks is to be a layer of roofing-felt or mortar, and in this mortar is to be bedded flooring-boards of the usual thickness. Such a floor would burn, but so slowly that fire would be a long time in working its way through. The aim is to gain time, for time is the one element of safety at all fires. For the roof, the supporting beams are to be of the same size, and the top is to be of matched planks 7.6 centimeters thick, and covered on the outside with any form of roofing that may be desired. The ends of the beams are to pass through the outer walls, and to be finished as brackets to support the planking that is carried to the ends of the beams.—*Century Magazine for December.*

OUR ANTHRACITE FUEL AND ITS EXHAUSTION.*

The territory occupied by the anthracite coal fields of Pennsylvania is but a diminutive spot compared with the area of bituminous coal in Pennsylvania alone, to say nothing of its vast extent in other portions of the United States, and in Great Britain, France and Belgium. The area of the anthracite of the United States is but 470 square miles, not one-twentieth the size of Lake Erie, while the wide-spread bituminous coal fields cover twice the area of our four great lakes. But the comparison with the bituminous area is deceptive, unless the relative thickness of the two is taken into consideration. If the anthracite beds were spread out as thinly as those of the bituminous region, they would cover eight times their present area, or 3,780 square miles.

The number and extent of the anthracite coal beds show a total thickness of 107 feet, distributed in fifteen workable beds, interstratified with a full mile in thickness of rock and shale, and are mainly confined to one-sixth of the area of the four mountainous counties of Luzern, Schuylkill, Carbon and Northumberland, in Pennsylvania.

The *fearful loss* of good material involved in mining and preparing anthracite, though greatly to be deplored, seems to be almost inevitable. The disposition of the coal in large, solid beds, and its highly inclined positions, involves strong supports to keep the superincumbent mass from crushing and closing the avenues to the mines; and these supports must consist of massive pillars of the solid coal itself. Wooden props, however ponderous and strong, can only be used for the minor supports. Some of this pillar coal is ultimately removed, but much of it is inevitably lost, especially in the larger beds, which frequently range from 20 to 40 feet in thickness, and are often inclined at an angle of from 40 to 70 degrees.

It is estimated that not more than 66 per cent. of the coal is ever taken out from the mines. That which is brought to the surface is run through a huge structure from 80 to 100 feet high, called a "breaker." There are over 300 of these immense buildings in the anthracite region, costing on an average $50,000 each, or an aggregate of $15,000,000. To the top of these the coal is hoisted, and then descends through a succession of rolls and screens, emerging at the bottom in a series of assorted sizes, from huge blocks of lump coal to unmerchantable dust, which forms a grievously large proportion of the whole. This process involves a loss of good coal, equal to 20 or 25 per cent. of the entire quantity mined. The coal wasted in mining, say 40 per cent., and in preparing, 25 per cent., is a total loss to landowner, miner and shipper.

Plans for utilizing the waste coal dirt, or culm of anthracite colleries, have been frequently suggested, but none have come into general use. The Anthracite Fuel Company, on Port Ewen, on the Hudson, in 1877, used 90 per cent. coal dust and 10 per cent. fuel pitch, and made 300 tons of fuel per day, consuming over 50,000 tons of culm. The Delaware & Hudson Company also use at their mines 60,000 tons per annum. They now ship all their coal down to pea sizes, and consume the culm in generating steam.

The Philadelphia & Reading R. R. Co. has recently introduced a method of burning coal dust in the furnaces of its engines, and the plan appears to meet with success.

The amount of water which drains into a vein is enormous. On an average five tons of water are hoisted for every ton of coal raised.

The bituminous coals, particularly those of the United States, are not subjected to these serious losses, and are quite cheaply mined and prepared. No breakers are required, as the only division is into coarse and fine coal, which are easily separated by screens; and the fine coal can be readily converted into coke, making a better condensed fuel than the coal in its natural shape. The bituminous veins are nearly horizontal and rarely more than 6 ft. thick, so that it not necessary to have extensive pillars, and as the coal is above the water level, with shallow basins, it is not necessary to put up extensive hoisting and pumping machinery.

The total amount of coal still to be mined is stated at 26,361,076,000 tons. The total waste as experience has shown is equal to two-thirds of the coal deposit, and reaches the amount of 17,574,000,666 tons, leaving us only 8,787,0075,000 tons to send to market.

The tables show that 360,017,817 tons have been sent to market in the 58 years from 1820 to 1878, inclusive. Our consumption now amounts to 20,000,000 tons annually. The increase of production for the past ten years has been 187,112,857 tons. At this rate we shall reach our probable maximum output of 50,000,000 tons in the year 1900, and will finally exhaust the supply in 186 years.

The present product of the anthracite coal fields is (1878) as follows:

	Collieries.	Tons.
Southern	40	1,229,081
Middle	180	9,529,525
Northern	128	7,680,990
Total	348	18,439,596

Partially successful experiments have been made to use petroleum as a substitute for coal to some extent. But is it not already evident, under the reckless prodigality of production, that this occult and mysterious supply of light, heat and color will be exhausted before the anthracite, and can, at best, only temporarily retard the consumption of the latter?

The question of the exhaustion of our coal supply is scarcely more at the present time than a curious and interesting calculation. It has not yet become so grave and portentous as in Great Britain, where a commission, with the Duke of Argyle, Sir Roderick Murchison and Sir W. G. Armstrong at its head, was recently appointed by Parliament to ascertain the probable duration of the coal supplies of the country. There it is serious indeed; for when Britain coal fields are exhausted her inherent vitality is gone, and her world-wide supremacy is on the wane.

In the twenty-three years from 1854 to 1876, inclusive, she produced the enormous quantity of 2,210,710,091 tons of coal; and exported only 222,196,109 tons—say ten per cent—consuming the rest within her own borders.

The average increase of her annual output has been 3½ per cent.

Our anthracite product, compared with the coal

* From a paper by P. W. Sheafer, read before the American Association for the Advancement of Science, August, 1880.

product of Great Britain, is so small as to really seem insignificant. The English commission counts as available all coal beds over one foot thick—we count nothing under two and a half feet thick, nor below 4,000 feet in depth—showing a net amount in the explored coal fields of 90,207,285,398 tons; estimated amount in concealed areas, 56,273,000,000 tons; total, 146,480,285,398 tons, distributed as follows:

	Explored.	Unexplored.	Total.
England	45,746,930,555	56,246,000,000	101,992,930,555
Wales	34,461,208,913	.....	34,461,208,913
Scotland	9,843,465,930	No estimate.	9,843,465,930
Ireland	155,680,000	27,000,000	182,680,000
Total	90,207,285,398	56,273,000,000	146,480,285,398

The exhaustion of this magnificent mass of coal at this present rate of increase, viz.: three and a half per cent. per annum, is estimated by Professor Jevons as follows:

1876, actual output	133,360,000 tons.
1886, estimated annual output	186,600,000 "
1896, " " "	261,200,000 "
1906, " " "	365,700,000 "
1916, " " "	512,000,000 "
1926, " " "	716,800,000 "
1936, " " "	1,003,500,000 "

Thus in sixty years the output would be nearly eight times the present amount, and about one-fourth of the total amount to be found in Great Britain.

We have about 340 collieries and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly 4,000 collieries and mines 132,000,000 tons, or 33,000 tons per colliery.

Most of the anthracite mining in the United States is now done at a less depth than 500 feet vertical; but as the coal nearer the surface becomes exhausted, the mine must go deeper and become more expensive. The coal resources of Great Britain are all developed now, and in process of depletion, while in this county, when our 470 square miles of anthracite are exhausted, we have more than 400 times that area, or 200,000 square miles, of bituminous coal from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for 200 years. With an annual production of 50,000,000 tons, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the bituminous supply would be reached in 800 years.

ANTHRACITE COAL AREAS OWNED BY THE SEVERAL COMPANIES, AND THE PER CENT. OF THE WHOLE IN TONS.

NAME OF COMPANY.	Schuylkill.		Middle.		Wyoming.	
	Acres.	P.c.	Acres.	P.c.	Acres.	P.c.
Lehigh Valley	.....	....	18,036	24	6,934	4
Lehigh & Wilkes-Barre	7,600	8	7,000	8	7,400	5
Delaware & Hudson	.....	....	.....	....	20,042	12
Del., Lacka. & Western	.....	....	.....	....	3,500	3
Pennsylvania Coal Co.	.....	....	.....	....	10,000	6
Phil. & Read. C. & I. Co.	65,306	70	23,250	32	.....	....
Pennsylvania R. R. Co.	6,000	6	9,000	9	5,823	....
Girard estate	.....	....	6,000	8	.....	6
Gilbert & Co.	.....	....	1,373	2	.....	....
Alliance Coal Mining Co.	3,172	3	.....	....	.....	....
All others	11,362	13	15,981	17	73,021	64
Total	93,440	100	80,640	100	126,720	100

RAILWAY PROGRESS IN GREECE.

The new condition of things in Greece is giving rise to much activity in the direction of improving communication. Not only is the cutting of the Isthmus of Corinth in hand, but railways are projected and will no doubt soon be begun between Athens and Larissa, and between Arta and Volo, in Northern Greece, while in the Peloponnesus one line is to run along the coast of the gulf from Corinth to Patras, another, starting from Corinth, will run south to Mycenæ and Argos, and then turning westward through Arcadia, passing Andritzena, Tripolis and Megalopolis, will again turn southward through the old Messenia and end at Kalamata on the Gulf of Koron. This line, besides opening up the peninsula for purposes of commerce, will traverse country of the highest interest to travelers, both from its associations in the past and its great natural beauty. A short line is to connect the little port of Katakolo on the coast of Elis with the thriving town of Pyrgos, which is not more than ten miles from Olympia. If these enterprises are well carried out an immense stride will have been taken by the Greek kingdom on the road to civilization. The history of the four-mile railway which connects Athens with the Piræus is encouraging to the projectors of the new lines. It was constructed originally at an outside cost of £800,000.—*Pall Mall Gazette.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Water-works are being discussed at Findlay, O., with probabilities that some definite action will be taken soon by the council.

Under the vigorous supervision of the contractors, Russell & Alexander, the new water-works of Topeka, Kan., are rapidly approaching completion.

Work upon the construction of the new water-works at Las Vegas, New Mexico, is being pushed rapidly forward, a large force of men being employed.

JOLIET, Ill., Dec. 13.—The Joliet common council tonight refused to accept the water-works built by Jesse W. Starr. This throws Starr out of $100,000.—*Chicago Times.*

It will be two weeks before the Arnold print works, North Adams, will have water from the tunnel, owing to the difficulty of obtaining iron pipe. The reservoir at the tunnel will be further excavated next spring, so as to hold 6,000,000 gallons of water.

Mr. John J. Osborn, hydraulic engineer, assisted by D. C. Sanford, C. E., is making surveys and plans for a public water supply of Wallingford, Conn. Mr. Sanford, on the evening of the 10th, read a preliminary report to a borough meeting in the Wallingford Town Hall.

The New Haven, Conn., Water Company are contemplating additional facilities for the public water supply of that city, and Engineers John I. Osborn and D. C. Sanford are now engaged in the necessary surveys. A dam and storage reservoir will be built. The estimated cost of various projects range from $69,000 to $97,000.

The Wilmington (N. C.) water-works were completed and successfully tested last month. The contractors for the works were Messrs. J. A. Cloud & Co., who also constructed the works at Jacksonville, Fla.; the pumping machinery was furnished by Messrs. H. R. Worthington & Co., and the interests of the city were looked after by the City Engineer, Mr. J. K. Brown.

The city of Cleveland, O., has just added to the pumping facilities of its water-works a new Worthington pump of 10,000,000 gallons capacity, has built a new boiler-house and machinery, and put in three new steel marine boilers 10x18 ft. Cost, including 1¼ miles of 30-in. main pipe laid, $250,000. They have laid about 12 miles of distributing pipe during the past year.

We regret to perceive a disposition on the part of some people in Austin to belittle the efforts of our fire department. Yesterday afternoon a gentleman from San Antonio was examining a photograph of the ruins of the burned capitol. "I don't see any firemen in the picture," remarked the stranger. "Well, you see, the firemen haven't got there yet. That's why they are not in the picture," said the artist.—*Texas Siftings.*

A water-works company has been formed to supply Hoboken, Union Hill and Weehawken, N. J., with water. These cities have heretofore received a supply from the Jersey City Water-works, but propose to have an independent organization. It is called the Hackensack Water Co., headquarters 47 Montgomery street, Jersey City. Messrs. Spielman & Brush are the engineers. The contract for reservoir has been let.

The Binghamton water-works, who use the Holly system, are putting in additional pumping facilities, and will, when complete, be able to supply 6,000,000 gallons of water every 24 hours. The steam cylinders, 4 in number, are 27-inch diameter, 33 inch stroke; the pump cylinders are 14⅝-inch diameter, 33-inch stroke, double action. The facilities they now possess give only 2,119,000 gallons per day on an average. The cost of the improvements over all, including new buildings, etc., will be $40,000.

The Indianapolis *Saturday Herald* drops, like Silas Wegg, into this timely bit of verse:

A plumber went forth to plumb
To a kingly palace by the way,
And when his half day's work was done
Presented his bill without delay.
The king brought forth his bags of gold,
His diamonds and his jeweled crown,
The plumber credit gave for them—
And took a mortgage on the throne.

The contract with the gas company for lighting the streets of Fond du Lac, Wis., having expired, and the common council having declined to make any further contract for that purpose, the streets are without light, except such as is afforded by the moon. This state of things will probably last for several months, until arrangements can be made for lighting with electricity, or investigation shall show that the electric light is impracticable. A committee of the common council is now examining the subject of the electric light with a view to its adoption if it is found suitable.

The following resolution was adopted June 18, 1881:

Resolved, That the Superintendent and Engineer of the Cleveland Water-Works be hereby directed to report to this Board at as early a date as is consistent with his other duties, a plan for supplying lake water to such districts of the city as lie above the plane that can be supplied from the present works, together with suggestions or recommendations of such changes, extension or enlargement of the present system as he may deem necessary to meet the demands for water for domestic, manufacturing and public use in this city in the near future.

A day or two since our esteemed friend, Mr. John C. Kelley, President of the National Meter Company, of this city, came into our office with a radiant smile illuming his features, and when queried as to the cause showed us two requisitions from the Water Board of Boston requesting him to deliver to E. R. Jones, Superintendent Eastern Division Boston Water-Works, 60 ⅝-inch, 5 1-inch, and 4 4-inch Crown water meters. We smiled in return and congratulated him upon the insertion of this opening wedge following so closely upon the wedge he drove when the meter was adopted by the Department of Public Works of this city.

The Youghiogheny Water Works Company at Bradford, Pa., is now in operation, the pipe being laid to the summit, 2½ miles, where the reservoir of 2,000,000 gallons capacity is situated. The pumps and engines, two in number, and of a recent patent, were manufactured by Cope & Maxwell, of Hamilton, Ohio, each having a capacity of 2,000 pounds every 24 hours. The works thus far, including pumps, engines, pipes (20-in.), tankage, building, etc., have already cost the company the sum of $75,000. The works are located at what is called the Slope Mine, where a neat and substantial building, of a hard blue stone, 42 x 80 ft., has been erected, in which the pumps are now in operation. In this building there is a well 30 ft. deep by 12 ft. in diameter, walled up and cemented. From this well there is a tunnel 5x3 ft. leading to the river, a distance of 100 ft. In this tunnel the water-pipe, 20 in. in diameter, is laid, which feeds the well from a natural basin in the river some 20 ft. deep. To prevent the well from being flooded during high water there is a cut-off in the feed-pipe by which the water is regulated. The water here is the best and purest that can be found anywhere—pure Youghiogheny water fresh from the mountains. These works now furnish water for the following coke works of H. C. Frick & Co., viz: The Henry Clay mines, 100 ovens; Frick mines, 106 ovens; Morgan mines, 164 ovens; Foundry mines, 74 ovens; White mines, 148 ovens; Eagle mines, 80 ovens; Summit mines, 142 ovens. Besides the reservoir at the Summit of 2,000,000 gallons capacity, there is already tankage along the line of 1,110,000 gallons capacity.

ELECTRICITY.

The common council of Lafayette, Ind., has accepted a proposition to place a twenty thousand candle-power electric light on the tower of the school building, agreeing to pay therefor the sum of $5,000 for two years.

The Electric Light Company, recently organized in San Antonio, Tex., ordered only a ten-light machine, and they have already applications for fifteen. The lights are to be 2,000 candle-power.

The city of Aurora, Ill., forty miles west of Chicago, affords a striking spectacle of the revolution in lighting cities by the electric tower plan. At night the city is bathed in a flood of lambent light, and her citizens are in a state of delighted enthusiasm over the splendid practical results achieved. The system consists of six electrical towers made of iron rods and network, each 150 feet high. These are crowned with electric lamps of 2,000 candle-power each, or equal to 125 gas jets. The cost complete for each tower and apparatus is about $1,000. One electric tower lamp, fed by soft coal at $3 per ton, gives a 2,000-candle light at 2¾ cents per hour—a ratio of 2½ to 50 compared to a corresponding use of gas light. The people of Aurora are universally jubilant over the result of the adoption of the new system, and express the most earnest and complete satisfaction with the Brush tower plan in all its bearings and aspects.

The wires that most need to be put underground in cities are those supplying electrical lights. As used at present they have proved extremely dangerous to property and involve a constant risk of life, and there seems to be no way of making them safe except by burying. W. A. Anderson has an exhaustive and valuable paper on this subject in the Fireman's Journal. The current of electricity necessary for a light is so strong that, if a wire is too small or is defective at any point, it becomes heated so as to set fire to any combustible substance near it, or if not properly insulated the current is likely to leave it and take a course where it will do mischief. Again, and this danger is worst of all, if the wires of light and of telephone or telegraph circuits happen to touch each other, a fire may be started wherever there is an instrument on the lines of the latter, so that, with light wires in the street, no building in the vicinity containing electrical instruments of any kind can be safe. Fires have been repeatedly caused in all these ways, and the insurance companies have taken the alarm and are trying to compel the use of large wires very carefully insulated, but it is evident that better security is needed than can be given by any possible precautions of the kind. The insulation might be destroyed by accidents, by the heat of imperfect wires, or imperceptibly by friction, and all these dangers would be indefinitely multiplied by the increase in the number of wires that seems certain to come. Edison's promised invention that was to destroy the gas companies has not appeared, but the electric light has advanced by degrees from its place as a scientific curiosity to use as an advertising device, and thence to adoption as a matter of economy. It has proved cheaper than gas under some circumstances, its use promises to increase with very great rapidity, and a method of burying the dangerous wires cannot be too soon perfected.—*Springfield Republican.*

STREETS, DRAINAGE, ETC.

A few weeks ago a very peculiar land slide occurred in Cleveland, O. Two ravines had been filled up to the

street grade about six years ago. A street had been made across the lower end 66 ft. wide, paved and flagged, with water and gas through it. One Saturday evening the whole body of the new fill and street, comprising about 200,000 yds. of earth, slid down, taking all with it, and completely demolishing everything in its way for about 2,000 ft., until it came to another street, which stopped it. The peculiarity of the slide is that the slope of the fill is only about 2 ft. in 100. The sight is an interesting study for civil engineers, and should be seen to be appreciated.

BRIDGES.

BLISSVILLE BRIDGE.—The Queens County Board of Supervisors had before it this week the action of the Joint Bridge Committee of Kings and Queens counties in dismissing Wm. H. McDonough, as engineer of the Blissville Bridge. Supervisor Van Nostrand, chairman of the Queens County committee, in his report to the full board says: "The committee was greatly disappointed, although not surprised, as we have been compelled for the past year to witness the blundering work of the so-called engineer, Wm. H. McDonough, to find the bridge itself too long to enter the approaches, and the said approaches too high to properly fit the bridge." The action of the Joint Committee in dismissing Mr. McDonough was ratified by a unanimous vote.—*Brooklyn Eagle.*

RAILROADS.

The Troy & Chatham Railroad Company filed articles of incorporation; capital, $1,000,000.

The Chinese Government has decided to lay a railway line, formerly between Shanghai and Woosung, from the coast of Formosa to the sugar districts. The line originally laid by foreigners was bought by the Chinese, torn up by the Mandarins, and the material and rolling stock transported to Formosa, where it has been allowed to remain idle until now.

At a recent meeting of the Chicago City Council Ald. Cullerton, assuring "his newspaper friends" that he was "acting in good faith," and that he was embarking in no blackmailing scheme, offered the following:

Ordered, That the corporation counsel be, and he is hereby, directed, at his earliest convenience, to prepare and send to this council an ordinance requiring all steam railroad companies operating cars within the limits of this city to pay an annual license fee of $15 for each and every freight car and $25 for each passenger car or coach, such license to begin on the 15th day of January, 1882.

Alds. Cullerton and Wickersham thought that the scheme was feasible, and that the railroad companies could be made to pay almost the entire running expenses of the city government; but Ald. Phelps denounced it as bosh. It would drive all railroad companies from the city. Ald. Lawler said the city had not yet received license from all the sources from which it was legal to draw it, and it would be foolish to tax the railroad companies until it had done this. He moved the reference of the order to the law department. It was so ordered.

The Lake Shore & Michigan Southern Railroad Company are erecting a magnificent building on the corner of St. Clair and Seneca streets, Cleveland, O., for their general offices. It is of Philadelphia pressed brick with elaborate stone trimmings, five stories high, 100 feet front on St. Clair street and 130 feet front on Seneca street, surmounted by a clock tower, making the height 115 feet. It is entirely fire-proof, having iron beams and brick arches. The interior will be very handsomely finished. The masonry work is being done under contract by Mr. S. C. Kane, of Cleveland, the carpenter work by Messrs. C. S. Brooks & Company, and the iron work by T. H. Brooks; the architect is Mr. Joseph Ireland.

Advices from Indianapolis indicate that matters are not progressing well with the Toledo, Delphos & Burlington system. It is said that W. J. Sherman, Chief Engineer; J. W. McElvaine, General Passenger and Ticket Agent; F. Sprague, Auditor, and J. H. Weller, Division Superintendent, have tendered their resignations. There is much surprise, and two causes are suggested—the unpopularity of the management and lack of confidence in the narrow-gauge system. The retiring officers return to standard-gauge roads.

Over four hundred miles of the road is in operation, extending into the Southern Ohio coal fields south and Veedersburg west.

The construction of extensions to the Ohio River at Ironton and to St. Louis was pushed with remarkable vigor until recently, when suddenly all worked stopped; hence it is feared that the embarrassment is not confined to the management. The prevailing conclusion is that either the road is suffering financial embarrassment or its backers have lost confidence in the system. There is also a quiet rumor that Vanderbilt is endeavoring to get control of the L. S. & M. S. outlet to St. Louis and for a feeder to the Ohio Railroad, which crosses at several points. If he should obtain control the road would be changed to a standard-gauge. Between Veedersburg and St. Louis the road is mostly graded, bridged, tied and the iron is down at many intermediate points.

The construction of the Milwaukee & Madison line has revealed a number of wonderful and exceedingly interesting facts. About eight miles west of Waukesha the place known as Summit Cut is located, measuring 3,600 ft. in length, and varying in depth from about 25 ft. to about 53 or 54 ft. The Summit Cut proved to be composed of very hard material for about two-thirds its entire length, being filled with bowlders imbedded in hardpan or cemented gravel, requiring steady, continuous blasting for a period of about seven months. The great depth of the cut and the hardness of the material necessarily required considerable time to excavate, and the great heat of the summer, followed by the excessive rains of the fall, retarded the progress of the work very much. The cut contains about 160,000 cubic yards of earth. A large amount of the material has been hauled for about a mile, and the excess wasted. On about three miles of the work, a little beyond Summit Cut, about 300,000 yards of hard-pan has been excavated. The work between Milwaukee and Madison has been exceeding heavy, about 1,600,000 cubic yards of earth having been excavated. Along the line sink-holes were continually discovered, these being all that remain of old lakes, now covered with thick growths of tamarack. Many of these old lakes still have some connection with surrounding bodies of water, and when the earth and vegetable growth was once removed, a pool of water was still there, in which numerous dog-fishes were found. One of these old lakes was uncovered near Summit Cut, and this has now been well filled up; still another was found near Douseman's station, forty feet deep and about eight hundred feet in length. Between Douseman and Sullivan station three others have also been filled, their depth varying from twenty to about forty-three feet; their length is about 1,100.

NEW PROJECTS.

The Newark, Ohio, Delaware & Northwestern Railroad Company, with a capital of $2,000,000.

Major Fuller, of the Palmer-Sullivan road, with a large corps of engineers and surveyors, arrived at Victoria, Texas, on the 8th.

The Northern Pacific propose building a line of its own on the northern bank of the Columbia River.

The railroad train in Germany that runs by electro-magnetism as the motive power continues to be a great success, and it will not be long ere the experiment is repeated in this country.

The management of the Indianapolis, Bloomington & Western Railroad has determined to extend the Indianapolis, Decatur & Springfield road (just acquired by lease) from Decatur to St. Louis. The surveys and construction are to be pushed with all possible dispatch.

Eleven hundred thousand dollars of the $1,500,000 capital needed to build the new mill at Lewiston, Me., is subscribed, and the balance is likely to come in soon. The stockholders want Governor Plaisted to call a session of the Legislature this winter so that they can work under a charter.

DALLAS, Dec. 8.—The management of the Chicago, Texas & Mexican Central Railroad will make a determined effort to reach Cleburne by Jan. 1, but the chances of succeeding are now doubtful. They have 800 piles to drive, 125 trestles and cut-outs to build, and twenty-five miles of track to lay and only twenty-three days to do it in.

Messrs. Darragh, Kelly & Hamilton, who were the contractors for the masonry work on the N. Y., C. & St. L. R. R., from Cleveland to Buffalo, have just completed their contract, and have done the largest amount of work in the shortest time on record. It is pronounced by competent judges to be a magnificent work. The stone used was largely from the quarries of the McDermott & Berea Stone Company.

Work will be commenced on a magnificent hotel on Crystal Bay, Lake Minnetonka, which will be one of the finest in the country for its size. It will cost in the neighborhood of $250,000, and will accommodate 2,000 permanent guests. It will be fitted up with every convenience that can be desired by the most exacting demands of the public. The bay at night will be lighted by electricity in the vicinity of the hotel.

The Salina & Northwestern Railroad, the charter of which was filed December 8, is designed as a feeder to the Union Pacific and the Missouri Pacific. Capital, $5,000,000. Route is from Salina, by the way of Lincoln Center, to the west line of the State at a point on the west of Sherman County, Kansas. The directors are, Sidney Dillon and Jay Gould, of New York; L. H. H. Clarke, of Omaha; G. T. Smith, of Kansas City; J. P. Asher, of Lawrence; O. L. Williams and H. P. Dillon, of Topeka.

A road will be built from Ainsworth to Tacoma called the Cascade Branch. The final reports of the engineers upon the several surveys are not yet made and can hardly be completed, owing to the severe season, but before next spring the company will, however, build the branch, and if a definite choice of routes can be made in season, work will be commenced from Ainsworth during the ensuing year. The road will pass through the Yakama Valley, a rich wheat-producing country.

A new railroad company has been formed under the name of the Arizona & Nevada Railroad and Transportation Company. Its object is the construction of a line between Callville, Nev., and Yuma, with extensions by rail or water, as may hereafter be determined, to Port Asabel and Libertad, on the Gulf of California. The company has been incorporated under the laws of Arizona, but has its principal business offices in San Francisco. The capital stock is $20,000,000.

The articles of association of the Tonawanda, Wiscoy & Genesee Valley Railroad Company, filed in Albany, Dec. 10, cover a proposed route from Canaadea, Allegheny County, N. Y., passing through Hume, Allegheny, Pike and Eagle to Arcade, Wyoming County, a distance of 26 miles. This is a narrow-gauge line and a link of the chain from Coudersport, Penna., to State Line, Wellsville and Arcade, a distance of 94 miles. The survey will commence immediately and the road will be built early in 1882.

The certificate of incorporation of the Tropical American Telegraph Company, limited, has been filed in the office of the county clerk at Freehold, N. J. The incorporators are Frederick M. Delano, of Detroit, Mich.; James H. Howard, of Boston, and James B. Richards, of New York. The object of the company is the construction and operation of telephone lines and exchanges in the several cities, towns and villages in the West India Islands (excepting those of Cuba), Central America, Panama, Venezula, United States of Colombia, British, Dutch, and French Guiana.

Several Newton (Mass.) capitalists propose to build a railroad beginning at Brookline and running through Newton Center and Highlands parallel with the Woonsocket Division of the New York & New England Railroad, crossing the city to Riverside, near Lower Falls, on the Boston & Albany. The road is meant for a connecting link between the main line of the Boston & Albany at Riverside and its branches at Brookline. It will be operated by the Boston & Albany. The scheme is in the hands of J. F. C. Hyde, of Newton, and the capital of $500,000 is fast being subscribed. The corporation will probably be organized in a few days.

Captain John Cowden's Lake Borgne outlet scheme, by the Barrataria canal, has just received influential backing. Messrs. Whitney and Hutchinson, of the Morgan Line, Superintendent Morse, of the New Orleans Pacific Railroad, and other influential business men have declared in favor of it. The gentlemen named, in company with Captain Thomas Scathers, called upon Mayor Shakespeare, of New Orleans, to secure his official influence in favor of the measure and his signature to a petition to Congress in its behalf. The Mayor refused to sign the petition in his official capacity for the reason that it was a matter for the action of the city council, but he cheerfully promised his personal influence in favor of the proposed ship channel to the Gulf. The gentlemen appeared before the council on Monday last to secure the indorsement of Cowden's plans.

As to the completion of the Northern Pacific road Mr. Villard said: "We are confident of running through trains by the 1st of September, 1883. At the end of 1882 we expect to be up to the furthest point in the Yellowstone Valley to which the main line will be built, and from the West the road will be built to the western base of the Rocky Mountains. This will leave less than 160 miles to be built to complete the road, but this portion of the line includes two tunnels, aggregating about 10,000 feet. This is the most difficult part of the road. I may state that one of the great advantages of the Northern Pacific road over every other Pacific railway is that from the summit of the Rocky Mountains to the Pacific Ocean, a distance of 900 miles, the main line will follow a steady down river grade. In the same distance the Central Pacific has to go over three summits of from 6,000 to 8,000 feet high."

PERILS OF WINTER SURVEYING.—WINNIPEG, Manitoba, Dec. 8.—Considerable excitement was caused today, at the Canadian Pacific railway offices, by the receipt of a rumor that the party surveying the route of the Saskatchewan branch had been caught in a severe blizzard, Douglas, the engineer in charge, being severely frozen and three of his men frozen to death. Gen. Rosser telegraphed to Brandon and Battleford, in the Northwestern territory, but nothing had been heard of the rumor at either place. When last heard of, Nov. 15, the party had crossed the South Saskatchewan, and were running in the direction of Edmonton. Gen. Rosser does not credit the rumor, as Douglas has a lengthened surveying experience and would take every precaution in a storm. The party were well provisioned and additional supplies were sent them recently. The Dominion lands survey party, which left Moose Mountain recently for Winnipeg, were caught in a storm on the plains. Brodie, the surveyor, in charge was severely frozen, and several of the party were also frozen. They suffered dreadful privation, the provisions giving out. When reduced to semi-starvation they killed a pony for food, and finally succeeded in getting back to Moose Mountain, where Brodie had to be left, the others of the party starting for the east via Fort Ellice.

CONTRACTING, MISCELLANEOUS, ETC.

The tunnel at Edwardsville, on the New Albany & St. Louis Air-Line Railroad, is now cut through and will soon be completed, at a cost of $650,000. Cars will be running between New Albany and Milltown, Crawford County by the 1st of January, and possibly a week earlier.

The bids have been opened for the construction of a two-story court-house for Gillespie County, at Fredericksburg, Texas: L. P. Boettler, $24,000; G. W. Konkle, $25,490; Henry Pauly, $28,570; Neumann & Lindahl, $27,500; J. A. Courtney & John Heiming, $22,521; T. W. Carrico, $27,243; Mr. Courtney's being by far the lowest bid.

The new dam on Mill River, Springfield, Mass., for the Howard & Bros.' railroad supply manufactory, which was designed by Stockwell Bettes and built by W. C. McClallan, of Chicopee, has been completed and was used for the first time last week. It is a very substantial stone structure of unique form for that part of the country, the face being of a slanting concave surface, which has the advantage of causing a great diminution of jar and sound, and of throwing the water away from the foot of the dam to prevent its wearing away the foundations. The structure is 125 ft long and 20 ft. high and of cut stone, with a granite coping. It has been in process of building since July 6, and has cost the company about $15,000. The company estimate that they have at least 200 horse power, and more can be made available. It is the plan next year to build up new mills along the site, capable of carrying on an extensive business.